EFFECTS OF OXIDATION ON COATINGS FOR LANGMUIR PROBES AND THEIR PHOTOEMISSION CHARACTERISTICS IN AN OXYGEN-RICH SPACE ENVIRONMENT. J. I. Samaniego[1,2,4], X. Wang[1,4], L. Andersson[4], D. Malaspina[4], R. E. Ergun[3,4], and M. Horanyi[1,2,4]. [1]NASA/SSERVI's Institute for Modeling Plasma, Atmosphere, and Cosmic Dust (IMPACT) at University of Colorado Boulder (3400 Marine St. Boulder, CO 80303 USA, josa3077@colorado.edu). [2]Department Physics, University of Colorado, Boulder CO 80303 USA. [3]Department for Astrophysical and Planetary Science, University of Colorado, Boulder CO 80303 USA. [4]Laboratory for Atmospheric and Space Physics (LASP), Boulder CO 80303 USA.

In oxygen-rich environments (e.g., planetary ionospheres), the surfaces of Langmuir probes have a risk to be oxidized. The oxidation layer on most of materials reduces the surface conductivity, causing the measured current-voltage (I-V) curves deviate from clean probes. We performed experiments to test and validate new coating materials that can minimize such oxidation effects on probe measurements.

Samples, including commonly used coatings (Titianium Nitride, DAG, and Gold), were exposed to a laboratory oxygen plasma and tested in argon plasma before and after oxygen exposure. Overall, the oxidation effect on the probe surface leads to measuring a more positive plasma potential, hotter electron temperature, and lower plasma density. Among all the testing materials, a new coating Iridium (Ir) show the least effect due to oxygen exposure on the probe measurements, which is likely attributed to the high conductivity of its oxide form.

We have also tested the photoemission characteristics after a probe is exposed to an oxygen plasma. The results are important for electric field probes that largely rely on probe photoemission to determine the local plasma potential. Our results show that all tested materials show a reduced photoemission current due to oxidation. Though AquaDAG (a graphite coating) has the least drop in the photoemission current, AquaDAG is known to erode over time. Comparatively, Ir shows a relatively small drop in photoemission current after oxidation among all the tested materials. Additionally, and high fluence exposure tests show that further oxidation has little change on the photoemission of Ir once oxidized. These results suggest Ir to be the most resilient to space missions expecting long term exposures to oxygen for both Langmuir probes and electric field probes.

Our results are also important for other plasma instruments that are sensitive to the potential variation of their electrode surfaces, such as Retarding Potential Analyzers (RPAs) and electrostatic analyzers. When these instruments are exposed to an oxygen-rich environment, their electrode surfaces may become oxidized, causing measurement errors.